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Occurrence and intensity of net and spot blotch of barley in South Tigray, Ethiopia

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Net and spot blotches of barley are among the most harmful foliar diseases causing significant economic losses. To investigate the prevalence and intensity of these diseases in Tigray, where barley is one of the major crops, disease assessment survey was conducted in 2015 main cropping season. It was based on inspection of barley fields randomly selected at 5 km intervals along accessible routes. The result showed net and spot blotches prevalence and intensity varied across locations within the zone and among districts. From 70 fields examined, 40% and 60% were affected by net and spot blotches, respectively. More than 70% incidence was noted in many locations of three districts except Raya –Alamata which was about 10%. The overall mean incidence and severity of net and spot blotch diseases were 26.6% & 25% and 29% & 16%, in that order. Therefore, continuous investigating of pathotypes and developing integrated management options for all diseases is utmost critical.

Key words: Barley, diseases, intensity, net blotch, spot blotch

INTRODUCTION

Barley (*Hordeum vulgare* L.), which appears to have been grown by the ancients long before other cereals were mentioned in recorded history (Badr et al., 2000), is also believed to have been cultivated in Ethiopia as early as 3000 B.C. (Gamst, 1969). For millennia it has been supplying the basic necessities of life (food, feed, beverages and roof thatching) for many in the Ethiopian highlands. It is the fifth most important cereal crop after Tef ((*Eragrostis tef*), maize (*Zea mays* L.) sorghum (*Sorghum bicolar* L.) and wheat (*Triticum aesvivum* L.) in Ethiopia where it is grown predominantly between the altitudes of 2000 and 3000 m above sea level (masl) (Lakew et al., 1996; CSA, 2013). It is mainly cultivated in the main rainy (June–September), residual moisture (September–January), and small rainy (March–July) season-production systems. It is one of the favourite crops of Ethiopian farmers because it is a source of food, grows in marginal areas, and the straw is a good source of stock feed and is used for thatching roofs and bedding (Yirga et al., 1998).

Although Ethiopia is a centre of diversity for barley, most of the country's farmers still obtain very low yields due to a combination of biotic and abiotic constraints. This yield level is lower than worldwide and national yield potential obtained under good managed plots in the country (MoA, 2014). The important biotic stresses include diseases, such as scald, net blotch, spot blotch and rusts, which can reduce yields by up to 67%. In Ethiopia 36 diseases of barley have been recorded (Stewart and Yirgu 1967; Bekele, 1985), with the major ones causing

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substantial yield losses (Bekele, 1985; Semeane and Wudneh, 1985; Hundie, 2005). Investigations on barley diseases have been going on for several years in Ethiopia, however, which was not intensive and did not include all growing areas of the country such as Tigray regional state. Thus, this study was initiated to provide the quantitative information on the distribution and intensity of net and spot blotch of barley diseases in South Tigray.

MATERIALS AND METHODS

Area Description

South is one of the zones in the Ethiopian region of Tigray. It is bordered on the South and West by the Amhara region, on the North by Southeastern zone, and on the East by the Afar region. The latitude and longitude of South Tigray zone is 12°57'37.19" and 39°31'41.91", respectively. The South zone is among the major barley-producing areas of the region (CSA, 2013). The coordinates and weather conditions of the surveyed districts within the zone is presented in Table 1.

Barley Diseases Assessment

Barley disease survey was conducted in four districts of South Tigray in 2015 main cropping season. The survey trips were made using the main roads and accessible routes in each survey district, and in each available barley field, stops were made at 5 km intervals based on vehicle odometers. At least five stops were made in each barley field depending on the farm size. The assessments were made when the crop growth stage (GS) was on average between the medium milk and early dough stages according to Zadoks *et al*., (1974) although there were some fields reached at the maturity stage. The prevalence of the diseases was computed using the number of fields affected divided by total number of fields assessed and expressed as a percentage. In addition, disease incidence (percentage of plants having at least one lesion) and severity (average percent of leaf area affected by the disease) was done on a scale of 0 – 9 severity scale with 0 representing no infection and 9 when all barley leaves dry due to infection by the diseases (Couture, 1980; Steffenson et al., 1996). The average disease index (DI) for each field was calculated as:

$$DI\ (\%) = \frac{\sum(\text{disease grade x number of plants in each grade})}{(\text{total number of plants x highest disease grade})} x100$$

RESULTS AND DISCUSSION

Net blotch and spot blotch were among the common diseases of barley in 2015 main cropping season. The survey results from south Tigray is presented in Table 2 & 3. The result of field survey in major barley growing areas of south Tigray indicated that the distribution and severity levels of net blotch and spot blotch varied among and/or within the districts (Table 2 & 3). Net blotch is caused by *Pyrenophora teres* anam. *Drechslera teres* and spot blotch is caused by *Cochliobolus sativus* on barley were reported in Ethiopia by Stewart and Yirgu (1967). The net blotch was among the important diseases of barley in 2015 main cropping season (Table 2). Net blotch is characterized by it symptoms that as pinpoint brown lesions, which elongate and produce fine, dark brown streaks along and across the leaf blades, creating a distinctive net-like pattern. Older lesions continue to elongate along leaf veins, and often are surrounded by a yellow margin (Agrios, 2005). The distribution of net blotch was reached 40%. The prevalence of the disease was higher (84.2%) in Emba-Alaje district followed by Enda-Mekoni district (56.5%). The lower prevalence of net botch was noted in Ofla district followed by Raya-Alamata district. The incidence range of net botch in Emba-Alaje, Enda-Mekoni, Ofla and Raya-Alamata was 0-100%, 0-100%, 0-70% and 0-10%, in that order. The mean incidence of the disease was higher in the former two districts with value of 27.8% and 60%, respectively. Similarly, the severity of the disease was as that of its incidence that higher severity was noted for having higher incidence. The mean severity of net blotch in Emba-Alaje, Enda-Mekoni, Ofla and Raya-Alamata was 28.1%, 23.5%, 15% and 10% respectively (Table 2).

About 60% of barely fields were affected by spot blotch indicating the wider distribution of the disease in south Tigray (Table 3). The spot blotch of barley is characterized by developing small circular or elliptical dark brown spots becoming surrounded by a chlorotic zone of varying width (Agrios, 2005). Spot blotch was widely distributed in Enda-Mekoni and Emba-Alaje districts with prevalence of more than 73%. The prevalence of spot botch in Ofla and Raya-Alamata was 20% and 26.1%, respectively. The maximum incidence (100%) was noted in Enda-Mekoni and Emba-Alaje districts followed by 80% in Ofla district. The mean incidence of the diseases was ranged from 9.1% to 55% in the former three districts. The severity of spot disease was also higher in Enda-Mekoni and Emba-Alaje districts with a range of 5-50% and 5-60% respectively. The severity in Ofla district was varied from lower (5%) as high as (20%), while, the lowest (5%) was noted in Raya-Alamata district (Table 3).

The wide distribution and high intensity of net blotch and spot blotch diseases in the South Tigray barley growing areas could be due to the suitable environmental conditions (temperature and precipitation) for disease development and growing of susceptible cultivars. Earlier research reviews on cereal disease records, pathogens involved, their distribution and importance and their management showed that net blotch and spot blotch remain to be among the most widely distributed and

Table 1: Coordinates and climatic conditions of the districts in the survey year in South Tigray

District	Altitude range (m)	Coordinates (range)		Weather condition (range)	
		Latitude (N)	Longitude (E)	Rain Fall (mm)	Temperature (^{o}C)
Raya-Alamata	1494-2512	12^{o}21'-12^{o}23'	039^{o}20'-039^{o}34'	400-700	16-27
Emba-Alaje	1902-2764	12^{o}52'-12^{o}59'	039^{o}26'-039^{o}33'	600-900	9-20
Enda-Mekoni	2288-2977	12^{o}44'-12^{o}49'	039^{o}31'-039^{o}32'	600-800	12-22
Ofla	1848-2727	12^{o}29'-12^{o}39'	039^{o}16'-039^{o}42'	700-800	10-22

Table 2. The prevalence and intensity of net blotch in south Tigray in 2015 cropping season

Districts	Inspected fields	Prevalence (%)	Incidence (%)		Severity (%)	
			Range	Mean	Range	Mean
Ofla	23	4.4	0-70	3	15	15
Enda-Mekoni	23	56.5	0-100	27.8	5-100	23.5
Emba-Alaje	19	84.2	0-100	60	5-60	28.1
Raya-Alamata	5	20	0-10	2	10	10
Total	**70**	**40**	**0-100**	**26.6**	**5-100**	**25**

Table 3: The prevalence and intensity of spot blotch in South Tigray in 2015 cropping season

Districts	inspected fields	Prevalence (%)	Incidence (%)		Severity (%)	
			Range	Mean	Range	Mean
Ofla	23	26.1	0-80	9.1	5-20	10.8
Enda-Mekoni	23	73.9	0-100	33	5-50	16.2
Emba-Alaje	19	78.9	0-100	55	5-60	19.7
Raya-Alamata	5	20	0-10	2	5	5
Total	**70**	**60**	**0-100**	**29**	**5-60**	**16**

economically important diseases in Ethiopia (Bekele, 1986; MRC, 2002; Shehabu and Tekalign, 2004; Hundie et al., 2011), at various agro-ecologies and in different farming systems in the country (Bekele, 1986). Similarly, Ayele et al., (2008), reported that net blotch occurred in relatively lower altitudes but with wider distribution in Tigray region. This study ascertained that net blotch and spot blotch were among the important diseases of barley in the majority of growing areas of various agro-ecologies and in different farming systems. However, their level of distribution and intensity considerably varied in different seasons and locations in the country in general and the region in particular. This variability could be possibly due to divergence in the climatic conditions, farming practices, resistance in cultivar and the development of physiological pathotypes of the pathogen. The physiological variability especially for net blotch was reported in Ethiopia (Tekaligne et al., 2005) and elsewhere in the world (Lehmensiek et al., 2010; Bentata et al., 2011).

CONCLUSIONS

The net blotch and spot blotch are important diseases of barley in Tigray region of Ethiopia in distribution, incidence and severity. Similar coordinated and systematic work should be done for both blotch diseases to subsequently type the most frequent and virulent pathotypes by barley production system and use them for resistance screening as well as incorporating in integrated disease management options.

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